

# Ontological Foundations of Conceptual Modelling Reconsidered: A Response

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**Abstract.** In their quest for theoretical foundations of conceptual modelling information systems researchers have turned to various disciplines for inspiration. However, the adaptation of theories, concepts, and vernaculars across disciplines has always proven to be difficult at least. In the debate paper “On Ontological Foundations of Conceptual Modelling” I have subjected the transposition of Mario Bunge’s ontology to an ontology for conceptual modelling (i.e., the so-called Bunge-Wand-Weber (BWW) ontology) to a critique. Six commentaries to the critique have been received. They are reviewed—not with the intention of a closing argument but rather with the intent to structure the debate, to clarify some misconceptions, and last but not least to encourage the curious reader to carry on with the debate beyond the scope of this issue of the SJIS.

*Key words:* conceptual modelling, ontology, Bunge-Wand-Weber ontology.

## 1 Recollection

The argument in the debate paper “On ontological foundations of conceptual modelling” (this issue, pp. 63-80) runs along the following lines:

Conceptual modelling is generally acknowledged as one of the most fundamental means in information systems development. The importance attributed

to conceptual modelling continues to encourage the development of Yet Another Modelling Approach (YAMA) while some keep asking for Not Another Modelling Approach (NAMA) not grounded in scientific theory. In response, researchers join in a quest for theoretical foundations of conceptual modelling. Venturing into various disciplines for inspiration they return with foundational theories of conceptual modelling rooted in different theoretical domains. Currently, it appears ontological theories are favoured since—for many—ontology still holds the promise of foundational knowledge about the world. In 1986 Yair Wand and Ron Weber commenced work on an ontological foundation for conceptual modelling. Having based their work on the ontology of Mario Bunge, it became known as Bunge-Wand-Weber (BWW) ontology. Wand and Weber understand (a) information systems as representations of users' perceptions of the real world and (b) information systems development as a transformation of these perceptions to an artefact representing these perceptions. Based on these assumptions, Wand and Weber claim that Bunge's ontology provides an appropriate theoretical foundation for conceptual modelling and information systems – as this ontology: (a) is concerned with the representation of the real world; (b) uses terminology and concepts relevant to information systems; (c) is to a large extent formalized; (d) provides formalisms and notations that can be re-used; (e) appears to be mature; and (f) provided Wand and Weber with insights when applied in different settings. However, claims regarding the validity of the BWW ontology had not been critically evaluated so far. It was thus the aim of my debate paper to contribute to such an evaluation, by subjecting the transposition of Bunge's ontology to the BWW ontology to a critique.

In my critique I have argued that the transposition does not warrant the claim that conceptual modelling and information systems—as understood by Wand and Weber—can be theoretically grounded in Bunge's ontology. My argument is based on an analysis of certain parts of the transposition, showing how crucial elements of Bunge's ontology were either dropped, ignored or modified to such an extent, that reference to Bunge's work in support of the validity of the BWW ontology is hardly justified. By briefly describing the consequences of the alterations I have shown that these alterations are not accidental but necessary, since without them it would be impossible to establish a connection between Bunge's ontology and the theoretical foundations of conceptual modelling and information systems in Wand and Weber's sense. Based on my understanding of conceptual modelling as being concerned with the representation of conceptual knowledge and my conviction that language is not ontologically committed (otherwise it would be a theory), I have generalised my findings and claimed that ontological foundations of conceptual modelling are impossible in principle—unless we understand “ontological

foundations” as dogmatic decrees. I concluded the debate paper with the invitation to reflect on the presuppositions underlying not only ontological but all knowledge claims—in the tradition of Kantian Critique.

It was during his sabbatical in 2005 that Karlheinz Kautz paid Queensland University of Technology a visit, providing me with the chance to converse with him about research I had conducted—partly with Helmut Klaus—while I was a member of a research team headed by Ron Weber. Having checked Karl’s more recent publications before our meeting, I was not surprised by his critical attitude towards our work on the determination of fit between organisational requirements and enterprise systems capabilities on the basis of the BWW ontology. I was, however, surprised by his familiarity with issues I had encountered while working with the BWW ontology. It turned out that his familiarity was partly due to a presentation by Ron Weber and a subsequent discussion of BWW ontology-related ideas at the IRIS conference in 2003. While presuppositions underlying the BWW have not yet been questioned in the literature, they obviously were at this Scandinavian conference. I am greatly indebted to Karl not only for offering me the opportunity to present some of my (and Helmut’s) ideas to the readers of the SJIS, but also for successfully soliciting critical and inspiring feedback from nine prominent information systems researchers. Karl’s offer to write this response has, however, left me with an ambivalent feeling. On the one hand, I welcome the opportunity to respond to my critics, to structure the debate, and to clarify some misconceptions. On the other hand, it gives me the burden of having the final say. I can only ensure the reader that the latter is not my intention: It shall be the final say just for technical reasons, but the debate should be carried on beyond this issue of the SJIS.

In part, the contributions of my critics go far beyond the scope of my debate paper. It is thus impossible to address every single issue raised. In the following summary and response I focus on issues I believe to be the most crucial ones. As mentioned above, the goal of this exercise is not to provide a final answer but to highlight some salient features of those issues under debate.

I am grateful to Andreas Opdahl, Ed Kazmierczak, Giancarlo Guizzardi, John Krogstie, Kalle Lyytinen, Karlheinz Kautz, Nicola Guarino, Ron Weber, Simon Milton, and Yair Wand for their contributions to this debate.

## 2 Critique

In the conclusion of my debate paper (this issue, p. 74) I referred to a paper by Klein and Lyytinen (1985) in which they described the lack of reflexivity in scientism and the ensuing consequences for information systems research conducted in the spirit of this paradigm. Lack of reflexivity basically means the inability to question the presuppositions underlying one's mode of inquiry and knowledge claims. In what became known as the Copernican Turn in philosophy, Kant first subjected popular assertions regarding the conditions of the possibility of knowledge to a critique, which eventually revealed presuppositions that were void. No longer bound by these presuppositions he was able to inverse traditional belief by famously denying "that all our knowledge must conform to objects" and suggesting instead "that objects must conform to our knowledge" (Kant 1784/2003, Bxvi).

Most of my critics recognised the Kantian spirit in my critical evaluation of claims for the validity of the BWW ontology as a theoretical foundation of conceptual modelling. They replied in the same spirit when they questioned the foundations on which I based my argument. However, for Opdahl as well as Wand and Weber the Kantian spirit of my critique was not evident. The latter rightfully suspected: "Perhaps [...] Wyssusek has [...] a particular notion of 'critical evaluation' that we fail to understand. For our part, we have followed a time-honored tradition in science—namely, that the validity of theories needs to be tested empirically" (Wand and Weber, this issue, p. 128). This had obvious consequences for the debate: By not recognising the critical method Opdahl, Wand, and Weber could hardly address the critique. They reiterated their claims for the validity of the BWW ontology and sought to substantiate these claims with references to "critical evaluations", meaning empirical studies and reflections on the application of the BWW ontology (e.g., Opdahl, this issue, pp. 96–98). Ultimately, Opdahl, Wand, and Weber resorted to a pragmatist notion of truth, according to which the validity of a theory is determined by its usefulness. Probably the gravest consequence of their position might be the refutation of (the need for) earnest philosophical considerations (Opdahl, this issue, p. 98; Wand and Weber, this issue, p. 129), which is not only at odds with the very idea of developing ontological foundations for conceptual modelling. It also renders void every reference to the 'authority' of philosophy in general and its branch ontology in particular.

### 3 Ontology and Ontologies

From Gruber's (1993) non-philosophical definition of ontology as a specification of a conceptualisation, to common-sense ontology, to the full-fledged doctrinal materialist ontology of Bunge, to formal ontology in the tradition of Husserl, to the denial of ontology by the logical positivists, to social and radical constructivism—there are many notions of ontology to choose from.

Supported by Lyytinen's and Krogstie's linguistic and semiotic considerations, Guarino and Guizzardi as well as Milton and Kazmierczak (all this issue) stress the need for ontological pluralism. This stance, however, has significant consequences for the general understanding of ontology. Far from being a true representation of what exists in the world in the most general terms, ontology becomes subject to pragmatic whims. An illustration: Modelling a "fairy information system" true to the BWW ontology would pose serious problems (see also Krogstie, this issue): Since fairies are fictions they cannot be modelled as things with properties. According to Bunge (1981, p. 30), fictions, ideas, and concepts are brain processes or classes thereof. Brain processes, however, are real and can thus be modelled as changes in the state of things, i.e., of brains. Pragmatically, setting up a "fairy ontology" on which to base the model of the fairy information system seems to be a more reasonable way to go. Such an opportunistic approach, however, can only be based on ontologies in Gruber's (1993) sense. As conceptual modellers we should leave it to our clients to believe in the reality of fairies or not. The ontological commitment is beyond representations: see below.

For me, the most intriguing and convincing argument regarding ontological pluralism comes from Lyytinen (this issue, p. 82): He likens the programme of Wand and Weber to the programme of the logical positivists of the Vienna Circle. In other words, he likens the quest for a universal ontology to the quest for a universal language in which every fact can be described (e.g., Carnap 1931, p. 437). The programme of logical positivism ultimately failed, but not without producing valuable insights. Lyytinen suggests that Wand and Weber's programme will likewise also eventually fail. The dream of the one universally valid representational scheme such as Leibniz' *mathesis universalis* will remain a dream (e.g., Eco 1995). Probably alluding to Popper's characterisation of scientific progress as being possible only through conjecture and refutation, Lyytinen claims that the execution of Wand and Weber's programme, as well as the considerations and debates triggered by it, contribute to our understanding of ontology and conceptual modelling. I cannot agree more.

## 4 Ontological Commitment

Closely connected to questions regarding our understanding of ontology are questions regarding ontological commitment. For BUNGE, ontological commitment is semantic commitment (or semantic assumptions). While the ontology is just a conceptual model consisting of ontological and other concepts, it is the ontological/semantic commitment that gives factual meaning to the ontological concepts. The ontological/semantic commitment basically determines the referents of the ontological concepts. It is here that the distinction between, e.g., realism and phenomenalism manifests itself (e.g., Bunge 1974, pp. 70–75, 108–111). On the basis of this understanding of ontological commitment conceptual models are not per se ontologically committed. Conceptual models can thus be understood as formalisms that allow various ontological/semantic interpretations (Bunge 1974, pp. 108–109).

Guarino and Guizzardi (this issue, p. 117), the proponents of formal ontology in the debate, seem to build on this separation of concerns when they write that “*formal* ontology is completely neutral for what concerns its domain of application”. However, subsequently they explain that “choices between alternative representation structures can only be justified on ontological grounds”, implying that some representation structures are per se ontologically committed. I cannot agree with this argument, since I believe that the “separation of concerns” addressed above should be applied consistently. I agree, however, that ontological interpretations of alternative representation structures may lead to the insight that under a given ontological interpretation the meanings of the alternative representation structures turn out not to be identical.

For Opdahl, Wand, and Weber, the issue of ontological commitment seems to be of different concern. While both parties claim to be ontological realists (Opdahl, this issue, p. 100; Wand and Weber, this issue, p. 129), the latter seem to commit themselves also to (social) constructivist views: “[B]y adopting Bunge’s concepts, we have acquired a socially constructed reality that has utility for us” (Wand and Weber, this issue, p. 131). Such a statement is not compatible with Bunge’s materialist ontology and critical-realist epistemology: “Constructivists systematically confuse reality with our representations of it: the explored with the explorer, facts with data, objective laws with law statements, assumptions with conventions. This is certainly not the way scientists proceed” (Bunge 1993, p. 215). “The idealist who does not distinguish a thing from any of its models cannot account for the multiplicity of schemata of one and the same thing” (Bunge 1977, p. 121). See also Opdahl (this issue, pp. 98–99) on this matter.

While Wand and Weber are certainly right when they claim that “name calling” is rather meaningless with respect to the implications of ontological assumptions, my critique regarding their lack of commitment to Bunge’s dialectical materialism was certainly not a request for “name calling”. Wand, Weber, Opdahl, Milton, and Kazmierczak (all this issue) are all committed to ontological realism. Such a commitment is, however, not sufficient when referring to Bunge’s ontology in support of the validity of the BWW ontology. As a realist I can believe in the existence of unicorns, fairies, ideas, and concepts. Yet Bunge is not only realist but also materialist and thus denies the reality of concepts. Hence, if we try to create conceptual models true to Bunge’s ontology, we cannot model “concepts” because “concepts” do not exist according to Bunge’s realist and materialist ontology. Obviously, there is more to “dialectical materialism” than just being a name (see also section “Bunge, Dialectical Materialism, Name-Calling”, p. 147).

The main thrust of my critique is concerned with issues that arise if an adaptation of a theory is performed narrowly in scope and selectively. It *does not* lead to the conclusion that such an approach is invalid in principle. However, it *does* lead to the conclusion that claims for the validity of the resultant theory cannot be based on the validity of the adapted theory—if salient features of this theory got lost or were substantially altered during transposition.

## 5 Conceptual Modelling

Milton and Kazmierczak (this issue, p. 88), referring to Smith (2004), argue that conceptual modelling is not about modelling conceptual knowledge but about modelling reality. They regard “conceptual modelling” as a misnomer. This idea is clearly in opposition to the genealogy of conceptual modelling I have provided in the debate paper. Given the responses it is evident that my genealogy suggests a universal consensus regarding the meaning of “conceptual modelling”—which is not the case. Not only Milton and Kazmierczak but also Guarino and Guizzardi, Opdahl, Wand and Weber (all this issue) stress that conceptual modelling ultimately is about modelling reality. Even if I can see their point by considering conceptual knowledge as some sort of mediator between reality and conceptual models, I am not convinced about the validity of this limitation of the scope of conceptual modelling. However, I understand that this view is necessary for the justification of the relevance of ontologies such as Bunge’s for the theoretical foundation of conceptual modelling.

The reasoning behind my objection to this view is as follows: From a pragmatic point of view, conceptual modellers frequently work with clients who

are seldom familiar with ontology. Hence, those clients are not likely to provide the conceptual modeller with ontologically sound conceptualisations of reality. I cannot imagine a fruitful dialogue between a client and a conceptual modeller in which the latter argues that the client cannot have a fairy information system because fairies are not real and that s/he rather should get a brain processes information system (I am drawing on Bunge here). From a theoretical point of view, conceptual models are representations. Representations can generally be understood as signs, i.e., as something that stands for something else, to someone in some capacity (see also Krogstie, this issue). Thus, limiting conceptual modelling to the representation of reality is an unnecessary constraint. Referring back to the sections on ontology and ontological commitment, conceptual modelling is about creating representational structures that are open to ontological interpretations. This understanding does not preclude the creation of conceptual models with reference to some ontology. However, the ontology will remain outside the representational structure and needs to be read into this structure whenever necessary.

## 6 Ontological Foundations of Conceptual Modelling

What are ontological foundations of conceptual modelling? What does it mean to ground conceptual modelling in ontology?

Based on the debate contributions, the question most fundamental to every effort towards the development of ontological foundations of conceptual modelling cannot be answered unanimously. For Opdahl, Wand, and Weber, ontology not only provides fundamental knowledge about reality; it is also a source of a minimal set of constructs that need to be denotable by the ultimate conceptual modelling language in order to be able to represent reality. Milton and Kazmirczak's response exhibits a similar understanding, yet they do not believe in the absoluteness of a single ontology. It seems that all of the aforementioned authors assume conceptual modelling languages to be ontologically committed. In Guarino and Guizzardi's response I recognise—rightly or wrongly—a separation of concerns, even if not consistently applied: Ontology is about reality in general; conceptual modelling is about modelling conceptual knowledge which is about reality and fictions. Conclusively, the ontological foundation is not concerned with conceptual modelling but with conceptual knowledge. Presupposing the separation of concerns, for Lyytinen, Krogstie, and myself the question of ontological foundations of conceptual modelling does not arise. Grounding conceptual knowledge in ontology is

acknowledged to be an important issue—however, not for conceptual modelers. Returning to Wand and Weber’s (1988) original motivation, the conceptual modeller’s concern should be the creation of an adequate representation of conceptual knowledge—whatever is considered adequate under each given set of circumstances. Pace my critics but, if the conceptual modeller goes beyond this concern, I believe s/he is leaving the domain of conceptual modelling.

## 7 Some Short Replies & Clarifications

### 7.1 Bunge, Dialectical Materialism, Name-Calling

Bunge wrote a substantial critique of dialectics and claimed occasionally that his materialism is not dialectical but scientific (e.g., Bunge 1975). Despite Bunge’s effort, Lyytinen, Krogstie, and I still have no issue with labelling Bunge’s ontology “dialectical materialist”. Bunge himself did not completely denounce dialectics in his ontology. He writes, admittedly somewhat cryptically: “*This new ontology* [i.e., scientific materialism] *is dynamicist but not dialectical. If preferred it keeps, elucidates and systematizes what is alive, but discards what is dead, in dialectics*” (Bunge 1981, p. 62, my emphasis).

### 7.2 Opdahl

(pp. 98–99) Opdahl claims that Gruber’s (1993) definition of ontology as “specification of a conceptualisation” is not necessarily in conflict with Bunge’s understanding of ontology. First, Gruber (1993) claims that his definition provides the word “ontology” with “certainly a different sense of the word than its use in philosophy”. Second, Bunge’s ontology is (ideally) a theory, i.e., “hypothetical-deductive system [...]. In particular, an ontological theory is a theory that contains and interrelates ontological categories, or generic concepts representing components or features of the world” (Bunge 1977, p. 11). While ontological commitment according to Gruber commits the user of an ontology to the use of a certain vocabulary, ontological commitment according to Bunge commits the user to assume the existence of what the ontological concepts refer to.

(p. 99) Opdahl states that I have misquoted him and Brian Henderson-Sellers. I am sorry for that.

(p. 99) Opdahl claims that it will eventually be possible to model “social constructs and mental concepts” on the basis of the BWW ontology. Since

concepts are fictions, my comments on the modelling of concepts and fairies (see sections 3 and 4, pp. 143–146) apply.

(p. 101 and note 7) Opdahl claims that Bunge’s semantics is not relevant for conceptual modelling since it is “semantics [...] *of science* and therefore not obviously relevant for conceptual modeling”. In note 7 Opdahl admits that Bunge’s ontology is also scientific. He tries to resolve this obvious contradiction by a line of reasoning which I fail to comprehend.

### 7.3 Guarino and Guizzardi

(p. 116) “... the author seems to fall in the same trap of Wand and Weber, namely, he also approaches ontology as if Bunge’s ontology was the only available scientific ontology.”: Here, Guarino and Guizzardi question the most fundamental presupposition of my critique: the position from which it was conducted. I cannot make excuses for having taken a position, since any critique requires a position. However, I can explain my *choice* of position: Bunge’s philosophy is the sole philosophical source of the BWW ontology. Had I chosen, for example, a phenomenological position, I would have had to dismiss the entire project outright (exogenous criticism). Staying close to the source allowed me to show contradictions (from) within the project (endogenous criticism). Guarino and Guizzardi’s critique and subsequent presentation of an alternative position and its consequences on the reasoning about ontological foundations of conceptual modelling illustrate the need for reflexivity in critique.

### 7.4 Wand and Weber

(p. 129) “Wyssusek ascribes several fairly extreme positions to Bunge ...”: This is not the case, since I have only paraphrased Bunge. He himself never tried to be ‘political correct’ (e.g., Matthews 2003). But this was not the point of my original remark. Rather I sought to highlight a conflict between his scientific approach in general and his occasional unscientific accusations levelled against works not based on scientism. For example, he frequently targets Heidegger, without having ever published a scientific analysis of Heidegger’s work. Thus, Bunge’s accusations against Heidegger’s work are unsubstantiated and unscientific.

(p. 133) “Wyssusek seems to take umbrage with our having relied on advice from our colleague, Mattessich ...”: My point is that Bunge’s ontology was not selected – in the literal meaning of the word. Drawing on H. A. Simon’s popular model of a decision process, informed selection presupposes

a problem statement (given), the design of or the search for solutions (not given), the establishment of selection criteria (not given). As a consequence, the ‘selection’ of Bunge’s ontology cannot be justified on rational grounds. Additionally, the invitation to propose an alternative ontology which is “better” than the BWW ontology (p. 135) is of little avail, as long as no selection/evaluation criteria are being provided (see also Lyytinen, this issue, p. 82, Guarino and Guizzardi, this issue, p. 116).

(p. 134) “How we describe the world is surely a fundamental ontological question.” This would only be the case if we follow Lyytinen (this issue, p. 82) by considering representation and reality as co-constitutive. Yet such a consideration would not be consistent with Bunge’s ontology.

## 8 Conclusions

The development of theoretical foundations of conceptual modelling on the basis of philosophical ontology poses major challenges. Some of those challenges have been addressed in my critique of Wand and Weber’s adaptation of Mario Bunge’s ontology for the purpose of ontological grounding of conceptual modelling. I have argued that this transposition of Bunge’s ontology to an ontology for conceptual modelling does not warrant the reference to Bunge’s work in support of the validity of the resultant Bunge-Wand-Weber ontology. My critique revealed that salient features of Bunge’s ontology got lost during the transposition. I have further sought to illustrate that this loss was not accidental but necessary in order to establish a connection between theoretical foundations of conceptual modelling and Bunge’s ontology. Finally, based on the belief that language is not ontologically committed (otherwise it would be a theory) I have questioned the plausibility of the project of ontological foundations of conceptual modelling in general.

The responses to my critique can be grouped with respect to their methodological stance into “critics” and “apologists” (which is not a valuation). Both groups responded accordingly. Even if methodological considerations were not at the centre of the debate, they had significant consequences on its content and structure. The debate clearly shows that the issues raised in my critique and in the responses are genuine and indeed debatable, i.e., there is no glib answer. It also shows that my critique is of limited scope and needs to be expanded, especially with respect to alternative notions of ontology and the relation between language and ontology. As expected, the plausibility of the project of ontological foundations of conceptual modelling in general cannot be determined easily once and for all—and critique needs to be reflexive.

Extrapolating the history of metaphysical thought, information systems researchers are likely to debate on the possibility and form of ontological foundations of conceptual modelling for many years to come.

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